

PACIFIC
ENVIRONMENTAL
GROUP, INC.

ALCO
INCENT

SEP 22 1994

September 22, 1994
Project 310-058.3A

Ms. Tina Berry
Unocal Corporation
2000 Crow Canyon Place, Suite 400
San Ramon, California 94583

Re: **Soil Vapor Extraction Feasibility Study**
Unocal Service Station 5760
376 Lewelling Boulevard at Usher Street
San Lorenzo, California

Dear Ms. Berry:

Pacific Environmental Group, Inc. (PACIFIC) is pleased to present the results of a soil vapor extraction (SVE) feasibility test performed for Unocal Corporation (Unocal) at the site referenced above. The SVE test was performed from August 8 to 13, 1994 to determine if SVE is an applicable technology for remediation of petroleum hydrocarbon-impacted soil and groundwater below the site.

BACKGROUND

Site Description

Two 12,000-gallon fiberglass underground storage tanks (USTs) and one 550-gallon waste oil tank were installed in 1987 to replace the original steel USTs and waste oil tank. Additional excavation and soil sampling was conducted in 1987 when product piping was excavated and removed. In September 1993, 12 borings were drilled as part of a property divestment program. Because hydrocarbon-impacted soils were encountered, three of the borings were converted to vapor extraction wells. In March 1994, the delineation of hydrocarbon-impacted soils was completed with the installation of two soil borings.

Geology/Hydrogeology

Lithology beneath the site consists of stratified alluvial deposits of sand and silty sand from the surface grade to a depth of approximately 6 to 14 feet below ground surface (bgs). A silt and silty clay zone extends to approximately 19 to 21 feet bgs and overlays a sand zone that extends to approximately 21 to 34 feet bgs. A basal clay unit extends to the total explored depth in each boring. Geologic cross-sections of the site and boring logs for wells used for SVE testing are presented as Attachment A.

Depth of water below the site has varied from approximately 14.5 to 22.5 feet bgs, and may fluctuated as much as 5 feet. Before the SVE testing was performed, depth to water in Wells U-1, U-3, U-4, U-6, and U-8 were found to be 18.35, 17.60, 18.40, 18.10, and 16.85 feet bgs, respectively.

TEST PROCEDURES

The SVE test included testing of Monitoring Wells U-1 and U-3 and the simultaneous monitoring of groundwater Monitoring Wells U-4, U-6, and U-8.

A vacuum was applied to Wells U-1 and U-3, using an internal combustion engine. Construction details for Wells U-1 and U-3 are included in Attachment B. A test set-up diagram is shown on Figure 3. Parameters monitored during the test included:

- o Applied vacuum
- o SVE flow rate
- o Soil vapor total petroleum hydrocarbons calculated as gasoline (TPH-g) and benzene concentrations by laboratory analysis (EPA Method 8015/8020)
- o Vacuum influence at the test observation wells (U-4, U-6, and U-8)

Test data are presented in Table 1.

Effective SVE Radius/Zone of Influence

The vacuum influence data from the tests on Wells U-1 and U-3 were normalized ($P_n = P_i/P_w$) and a linear regression analysis was performed to determine the effective SVE radius of influence, where:

P_i = vacuum influence observed at test observation wells,

P_n = nominalized vacuum influence at test observation wells, and

P_w = vacuum applied to test well.

The maximum effective SVE radius of influence was selected as the radius away from the test well where vacuum influence was approximately 1 percent of the vacuum applied to the test well (Buscheck, et al. - 1991). The analysis determined that the effective SVE radius is approximately 11.0 feet for Well U-1 and approximately 20.5 feet for Well U-3. The average SVE radius of influence is 15.8 feet. Effective SVE radius of influence calculations are presented as Attachment B.

Soil Vapor Composition

Analytical results for the soil vapor samples obtained during the test are summarized in Table 1. Certified analytical reports are presented as Attachment C.

Petroleum Hydrocarbon Removal Rates

Estimated hydrocarbon mass removal rates for the SVE tests are summarized in Table 1. The mass removal rates estimated for the SVE test ranged from 3.4 to 5.0 pounds of TPH-g per day, and from 0.02 to 0.07 pounds benzene per day.

Discussion

Based on the results of the SVE test performed at the referenced site, it appears that SVE is an applicable technology for removal of petroleum hydrocarbons from soil and groundwater below the site.

Petroleum hydrocarbon removal rates observed during the test were moderate (less than 5.0 pounds TPH-g per day). The removal rate is consistent with the observed hydrocarbon distribution. TPH-g in soil concentrations observed during previous site investigations were generally low. In addition, it was found that a sample port located at the water knockout was inadvertently left open. As a result, the true hydrocarbon concentrations in the soil vapor were probably diluted.

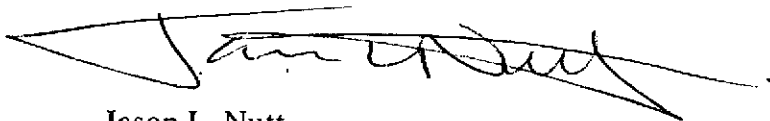
During the test a high moisture content was observed in the soil vapor. This condition suggests that the vadose zone is relatively moist. As a result, vacuum extraction influence and hydrocarbon extraction rates are somewhat limited. As moisture is removed, this condition will change.

Only laboratory analytical data were used for petroleum hydrocarbon removal estimates due to the discrepancy in TPH-g concentrations between the laboratory and flame-ionization detector analysis.

If you have any questions regarding this letter, please call.

Sincerely,

Pacific Environmental Group, Inc.



Jason L. Nutt
Staff Engineer



Robert L. Giattino
Project Engineer

REFERENCES

Buscheck, T.E., et al., *Summary of Nation-Wide Vapor Extraction System Performance Study. Proceedings of the Petroleum Hydrocarbons and Organic Chemicals in Groundwater: Prevention, Detection, and Restoration*, November 1991.

Johnson, P.C., et al., *Quantitative Analysis for the Cleanup of Hydrocarbon Contaminated Soils by In-Situ Soil Venting*, Ground Water, May-June 1990.

Attachments: Table 1 - Soil Vapor Extraction System Removal Data -
Total Petroleum Hydrocarbons
(TPH as Gasoline and Benzene)
Table 2 - Soil Vapor Extraction System Mass Emission Rates and
Destruction Efficiencies - Total Petroleum Hydrocarbons
(TPH as Gasoline and Benzene)
Figure 1 - Site Location Map
Figure 2 - Site Map
Figure 3 - Soil Vapor Extraction Test Set-up Diagram
Attachment A - Geologic Cross-Sections and Boring Logs
Attachment B - Radius of Influence Calculations
Attachment C - Certified Analytical Reports

cc: Ms. Juliet Shin, Alameda County Health Care Services

Table 1
Soil Vapor Extraction System Mass Removal Data
 Total Petroleum Hydrocarbons
 (TPH as Gasoline and Benzene)

Unocal Service Station 5760
 376 Lewelling Boulevard at Usher Street
 San Lorenzo, California

Sample I.D.	Date Sampled	Hourmeter Reading (hours)	Flow Rate (scfm)	TPH as Gasoline			Benzene		
				Influent Concentration (ppmv)	Removal Rate (lbs/day)	Removed to Date (lbs)	Influent Concentration (ppmv)	Removal Rate (lbs/day)	Removed to Date (lbs)
INFL	08/08/94 a	212	44	234	3.9	0.0	4.0	0.06	0.00
INFL	08/09/94	219	67	132	3.4	1.1	1.1	0.02	0.01
INFL	08/11/94	265	62	206	4.8	8.9	2.1	0.04	0.07
INFL	08/13/94	311	37	355	5.0	18.4	6.0	0.07	0.18
TOTAL POUNDS REMOVED:				TPH as Gasoline:		18.4	Benzene:		0.18
scfm = Standard cubic feet per minute ppmv = Parts per million by volume lbs = Pounds a. 5-Day Pilot SVE test startup on August 8, 1994. Analytes reported in ppmv are converted from micrograms per liter. See certified analytical reports for detection limits.									

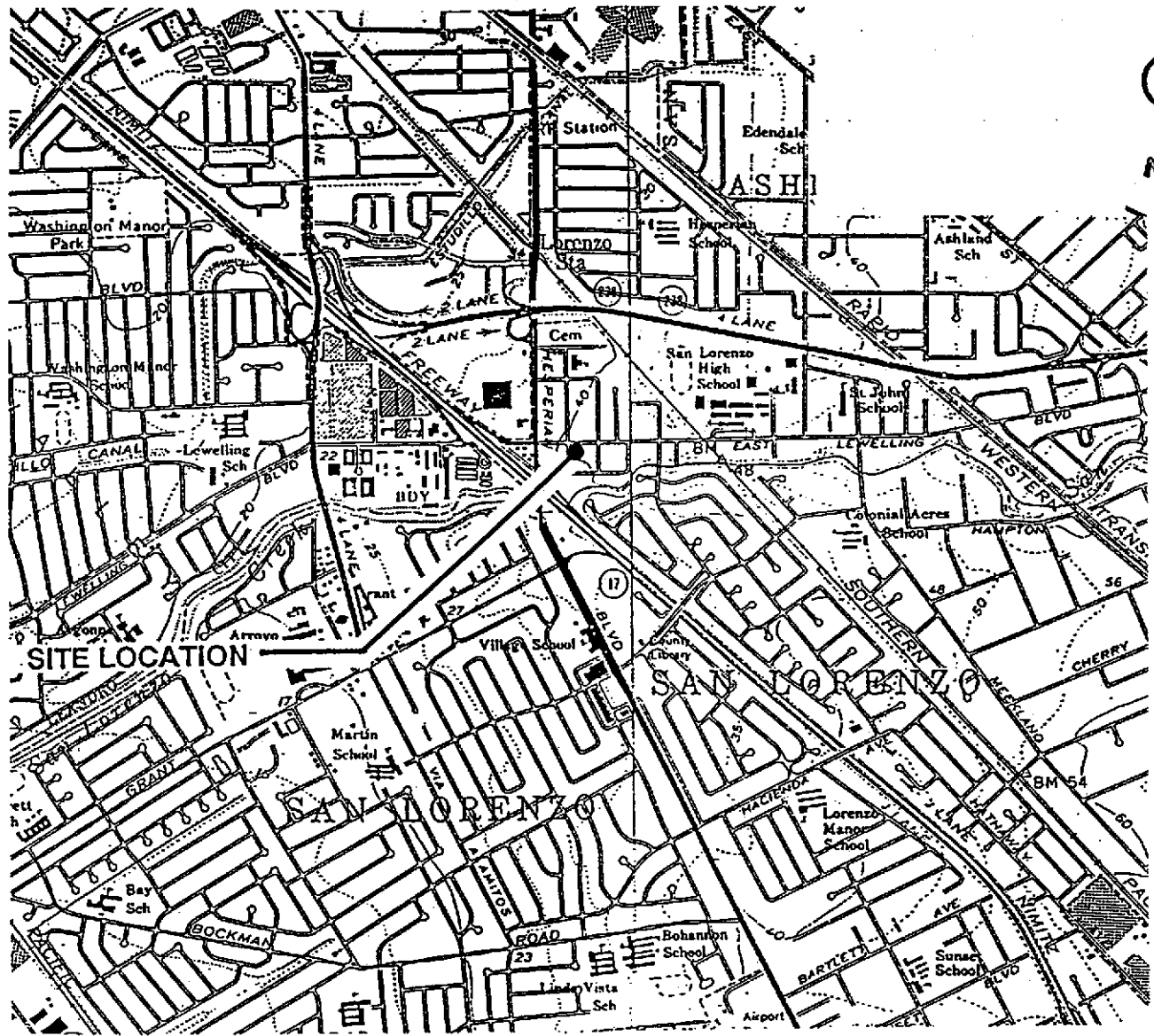
Table 2
Soil Vapor Extraction System Mass Emission Rates and Destruction Efficiencies
 Total Petroleum Hydrocarbons
 (TPH as Gasoline and Benzene)

Unocal Service Station 5760
 376 Lewelling Boulevard at Usher Street
 San Lorenzo, California

Sample I.D.	Date Sampled	Hourmeter Reading (hours)	Flow Rate (scfm)	TPH as Gasoline			Benzene		
				Effluent Concentration (ppmv)	Emission Rate (lbs/day)	Destruction Efficiency (percent)	Effluent Concentration (ppmv)	Emission Rate (lbs/day)	Destruction Efficiency (percent)
EFFL	08/08/94 a	212	44	19	0.32	91.8	ND	0.0004	99.3
EFFL	08/11/94	265	62	3.5	0.08	98.3	ND	0.0006	98.6
EFFL	08/13/94	311	37	ND	0.03	99.3	0.06	0.0007	99.0

scfm = Standard cubic feet per minute
 ppmv = Parts per million by volume
 lbs = Pounds
 ND = Not detected

a. 5-Day Pilot SVE test startup on August 8, 1994.
 Emission rates for values reported as ND are calculated using the detection limit.
 Analytes reported in ppmv are converted from micrograms per liter.
 See certified analytical reports for detection limits.

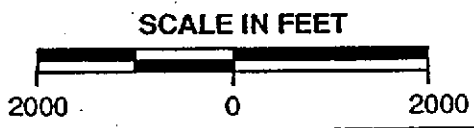


SITE LOCATION



QUADRANGLE LOCATION

REFERENCES:
 USGS 7.5 MIN. TOPOGRAPHIC MAP
 TITLED: CALAVERAS, CALIFORNIA
 DATED: 1961 REVISED: 1980
 TITLED: SAN JOSE EAST, CALIFORNIA
 DATED: 1961 REVISED: 1980



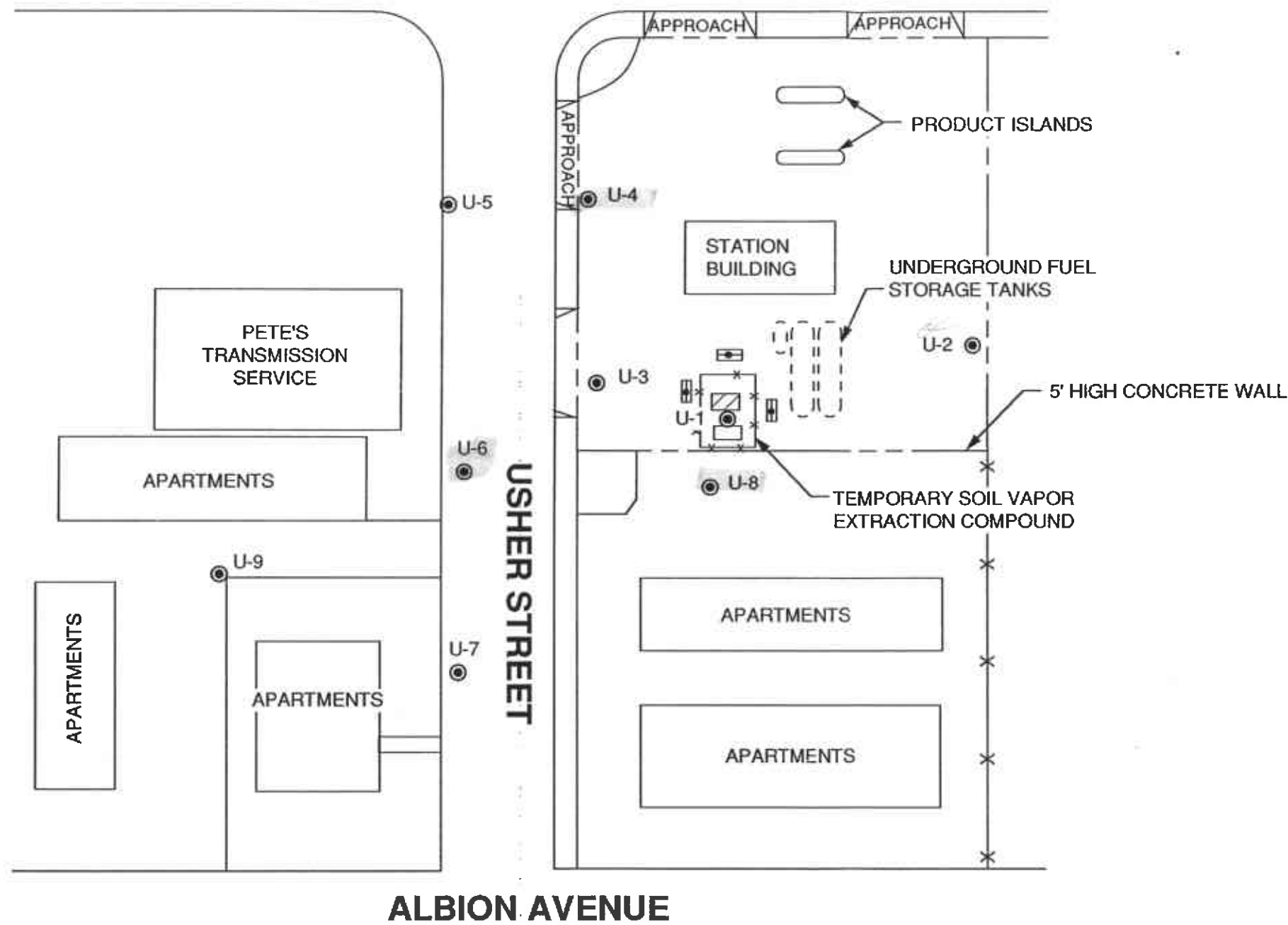

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UNOCAL SERVICE STATION 5760
376 Lewelling Boulevard at Usher Street
San Lorenzo, California

SITE LOCATION MAP

FIGURE:
1
PROJECT:
310-058.5A

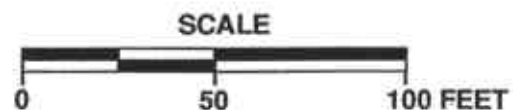
LEWELLING BOULEVARD



LEGEND
 U-2 ● GROUNDWATER MONITORING WELL LOCATION AND DESIGNATION



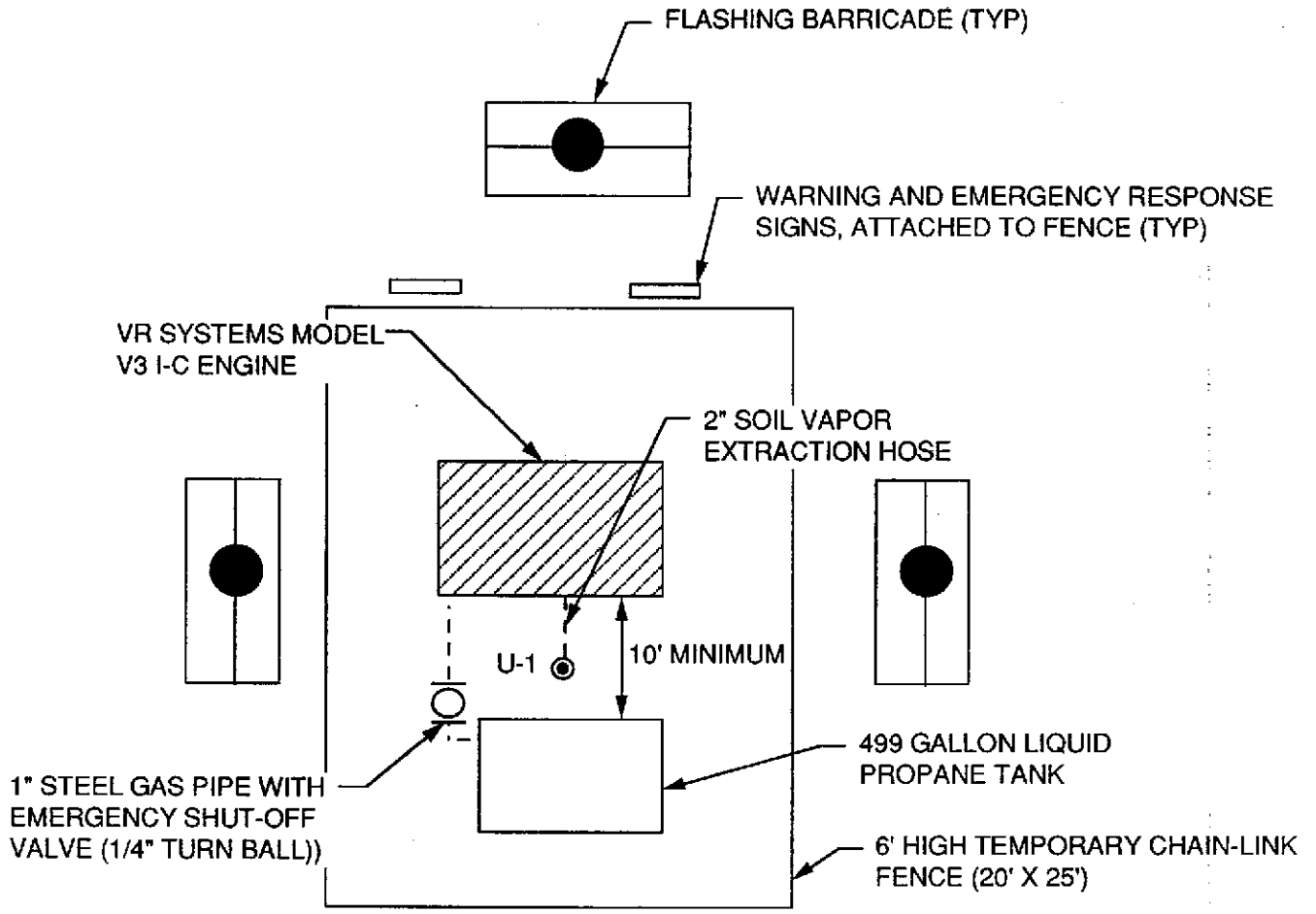
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UNOCAL SERVICE STATION 5760
376 Lewelling Boulevard at Usher Street
San Lorenzo, California

SITE MAP

FIGURE:
2
PROJECT:
310-058.3A



NOT TO SCALE



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UNOCAL SERVICE STATION 5760
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SOIL VAPOR EXTRACTION TEST SET-UP DIAGRAM

FIGURE:
3
PROJECT:
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